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DOCKET NO: 463P065

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application
of: **Masahiro Ohishi** and **Mitsuru Kanokogi**

Serial No.:   **Not yet assigned**
Group Art Unit: **Not yet assigned**
Filing Date: **Herewith by Express Mail**
Examiner: **Not yet assigned**

For: **DISTANCE MEASURING SYSTEM**

> EXPRESS MAIL LABEL NO.: **EK127983583US**
> DATE OF DEPOSIT: **April 26, 2000**

BOX: **X**   Patent Application

          ____   Provisional   ____   Design   ____   Sequence

Assistant Commissioner for Patents
Washington, D.C.   20231

Sir:

PATENT APPLICATION TRANSMITTAL LETTER

Transmitted herewith for filing, please find:

X   A Utility Patent Application.

If this is a continuing application, please check appropriate
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          ____   Continuation ____   Divisional ____   Continuation-in-
part of prior application _____

          ____   A Design Patent Application.

DOCKET NO: **463P065**

Including the following:

_____ Provisional Application Cover Sheet.

_____ New or Revised specification, including pages _____
containing:
_____ Specification
_____ Claims
_____ Abstract

_____ A copy of earlier application Serial No. _____ Filed
_____ to which no new matter has been added,
TOGETHER WITH a copy of the executed oath or declaration,
Associate Power of Attorney and Change of Adress for such
earlier application and all drawings and appendices. Such
earlier application is hereby incorporated into the present
application by reference.

_____ A copy of executed oath or declaration for earlier application
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disclosure of such earlier application is considered as being
part of the disclosure of the present application and is
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_____ Please enter the following amendment to the Specification
under the Cross Reference to Related Applications section (or
create such a section): **"This application is.."**

_____ Signed Statement attached deleting inventor(s) named in the
prior application.

_____ Preliminary Amendment is enclosed.

X **Three (3)** _____ Sheet(s) of Drawings.

X An **X** Executed _____ Unexecuted
Declaration or Oath and Power of Attorney.

_____ Associate Power of Attorney

X An Executed Assignment of the Invention to:
Kabushiki Kaisha TOPCON

X A Recordation Form Cover Sheet.

X Recording Fee - $40.00.

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DOCKET NO: **463P065**

X Priority is claimed under 35 U.S.C. §119 of:
Japanese Patent Application No: 134483/1999 filed May 14, 1999 in Japan

A certified copy of the foregoing application for which priority is claimed:

_____ is enclosed.

X will be submitted in due course

_____ was filed in the prior application.

_____ was transmitted by the International Bureau under International Application No.   filed   .

_____ An _____ Executed _____ Copy of Earlier Statement Claiming Small Entity Status under 37 C.F.R. 1.9 and 1.27

_____ is enclosed.

_____ has been filed in prior application Serial No. _____ filed _____, said status is still proper and desired in present case.

_____ Diskette Containing DNA/Amino Acid Sequence Information.

_____ Statement to Support submission of DNA/Amino Acid Sequence Information.

_____ Letter of Reference to Computer Readable Form.

_____ Information Disclosure Statement.

_____ Attached Form 1449.
_____ Copies of each of the references listed on the attached Form PTO-1449 are enclosed herewith.

_____ Petition for Extension of Time for parent application, Together with the appropriate extension fee.

_____ Appended Materials as follows: _____.

X Return Receipt Postcard specifically itemized.

_____ Other as follows:

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DOCKET NO: **463P065**

FEE CALCULATION   **BASIC FEES**

Design Application $310.00
Utility Application $690.00

For	Number Filed	Number Extra	Rate	Fee
Basic Fee				$ 690.00
Total Claims	7 - 20	0	x $18.00	= $ 0.00
Independent Claims	1 - 3	0	x $78.00	= $ 0.00
Multiple Dependent Claims			+ $260.00	= $ 0.00
		TOTAL FILING FEES		$ 690.00

X A Check is enclosed in the amount of ___**$690.00**___ .

X The Commissioner is authorized to charge payment of the following fees and to refund any overpayment associated with this communication or during the pendency of this application to deposit account ___**14-0930**___ . This sheet is provided in duplicate.

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X Any additional filing fees required, including fees for the presentation of extra claims under 37 C.F.R. 1.16.

X Any additional patent application processing fees under 37 C.F.R. 1.17 or 1.20(d).

_____ The issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: **Masahiro Ohishi** and **Mitsuru Kanokogi**

For: **DISTANCE MEASURING SYSTEM**

Assistant Commissioner of Patents and Trademarks
Washington, D.C. 20231
Sir:

LETTER

The above-identified applicant encloses for filing a patent application entitled "**DISTANCE MEASURING SYSTEM**". Said attached patent application includes **(1)** Patent Application Transmittal Letter (5-Pages)(in duplicate); **(2)** Patent Application: 20-Page Specification (including 1-Page cover sheet, 2-Pages of Claims (7) and 1-Page Abstract), 3-sheets of A4 size drawings an executed Combined Declaration and Power of Attorney (1-Page); **(3)** Check in the amount of $690.00 in payment of Filing Fee; **(4)** Recordation Form cover sheet (1-Page), Assignment (1-Page); and **(5)** Check in the amount of $40.00 in payment of the Recording Fee.

All correspondence concerning this application should be mailed to:

Kevin S. Lemack
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Respectfully submitted,

Kevin S. Lemack
Attorney for Applicant
Registration No. 32,579

Date:_____**April 26, 2000**_____

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

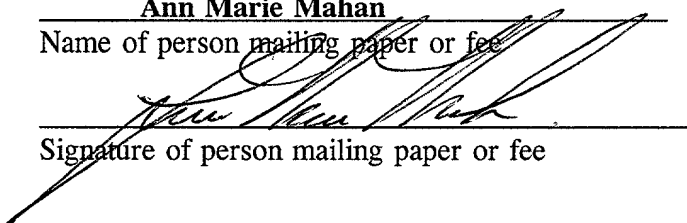|		
Applicants	:	Masahiro Ohishi, et al.
Serial No.	:	Not yet assigned
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For	:	DISTANCE MEASURING SYSTEM
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Ann Marie Mahan
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COMPLETE SPECIFICATION

TO BE

FILED

I N

UNITED STATES OF AMERICA

FOR

DISTANCE MEASURING SYSTEM

Applicants: Masahiro OHISHI   a subject of Japan
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DISTANCE MEASURING SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to a distance measuring system for measuring a distance to an object to be measured by projecting a distance measuring light beam toward the object and by receiving the reflection light beam from the object, and in particular, to a distance measuring system for measuring a distance by receiving the light beam reflected from a surface of an object to be measured or by installing a prism on the object to be measured and by receiving the reflection light beam reflected from the prism.

In recent years, a new type of a distance measuring system has appeared, by which a distance to an object to be measured can be determined without using a prism for reflecting a distance measuring light beam. This new type of the distance measuring system measures the distance by receiving the weak reflection light beam reflected from the surface of the object to be measured itself or by emitting a pulsed light beam with high peak power and by receiving the reflection light beam reflected from the surface of the object to be measured itself.

Also, a type of a distance measuring system has appeared recently, which can measure a distance in a prism measurement mode using a prism and also in a non-prism measurement mode without using a prism. In this measuring system, both the prism measurement mode and the non-prism measurement mode can be selected depending on each application or situation. Because the measurement mode can

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be selected, there is no need to provide a light wave range-finder in the prism measurement mode and a laser range-finder in the non-prism measurement mode, and this is very convenient and advantageous for the user. When the measuring position should be clearly defined and the measurement should be performed with high accuracy in the distance measuring system, which has functions to measure the distance in both of the two measurement modes, i.e. the prism measurement mode and the non-prism measurement mode, the distance is measured using the prism. If it is difficult to install the prism on the object to be measured, and if the measurement may not be so accurate as in the measurement using the prism and the approximate distance would be measured, the distance is measured without using the prism.

In a conventional type of a distance measuring system with a non-prism measuring function, the distance is measured by receiving the reflection light beam from the object to be measured with a very small reflection light amount. For this reason, it is designed in such manner that photodetection sensitivity is set to a higher value or an exit light amount of the distance measuring light is set to a higher value. In this respect, even when the prism is not correctly collimated in the prism measurement mode, the measurement may be performed using reflection light beam from the surface of an object other than the prism, e.g. a natural object. In this case, the incorrectly measured distance value may be displayed on a display unit of the distance measuring system.

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In particular, when the user measures the distance using the prism, the distance must be measured with high accuracy as described above. If the distance is measured even though the prism is not correctly collimated, the user may acquire an incorrect distance value without becoming aware of incorrectness of the data. In addition, when there is an obstacle before the prism and a part of the distance measuring light beams hits the obstacle, the user may measure the distance to the obstacle without being aware that it is not the object to be measured. Furthermore, even when the user becomes aware, it is difficult to judge which is correctly measured, the obstacle or the object to be measured.

These problems did not occur in case of the conventional type of a light wave range-finder, which can measure the distance only in the prism measurement mode. That is, in case of the conventional type of the light wave range-finder, the distance cannot be measured unless the sufficient light amount is reflected as the reflection light beam from the prism. If the distance is not measured in the conventional type of the system, it means that the prism is not correctly collimated. Thus, incorrect measurement of an object other than the prism did not occur in the conventional type of the system.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a distance measuring system, by which a type of an object to be measured is judged from a photodetection amount of a

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light beam reflected from the object to be measured and from a measured distance value, and it is possible to eliminate incorrect measurement in case of prism measurement.

To attain the above object, the distance measuring system according to the present invention comprises a control arithmetic unit, a light emitting unit for emitting a measuring light beam and a photodetection unit for receiving a reflection light beam from an object to be measured, and the system being used for measuring a distance by receiving the reflection light beam from the object to be measured, wherein the control arithmetic unit compares a signal based on photodetection amount of the light from the object to be measured as well as a result of distance measurement with a reference data prestored in the control arithmetic unit relating to reflection of the object to be measured, and judges the object to be measured based on a result of the comparison. Also, the present invention provides the distance measuring system as described above, further comprising a density filter for adjusting the photodetection amount of the light beam from the object to be measured, wherein the signal based on the photodetection amount represents a density position of the density filter, and the reference data relating to reflection of the object to be measured is obtained by associating a measured distance with the density position of the density filter. Further, the present invention provides the distance measuring system as described above, wherein the density filter is a disk where density is continuously changed in a circumferential direction, the density filter is rotated by

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a stepping motor, and the density position corresponds to a number of rotating steps of the stepping motor. Also, the present invention provides the distance measuring system as described above, wherein the reference data relating to the reflection of the object to be measured contains change of the photodetection amount due to weather conditions as a tolerance value. Further, the present invention provides the distance measuring system as described above, further comprising a display unit, wherein a result of judgment on the object to be measured is displayed on the display unit. Also, the present invention provides the distance measuring system as described above, wherein there are provided at least a prism measurement mode and a non-prism measurement mode, and when the prism mode is selected, the distance is displayed on the display unit only when the object to be measured is judged as a corner cube, and the fact that the object to be measured is not a corner cube is displayed on the display unit when the object to be measured is not judged as a corner cube. Further, the present invention provides the distance measuring system as described above, wherein photodetection sensitivity can be automatically changed over according to the photodetection amount of the light beam from the object to be measured, the object to be measured is judged according to the photodetection amount, and a result of judgment on the object to be measured is displayed on the display unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematical block diagram of an embodiment

of the present invention;

Fig. 2 is a drawing to explain a density filter to be used in the embodiment;

Fig. 3 is a diagram showing a difference of a light amount between a light beam received from a prism and a light beam received from a natural object;

Fig. 4 is a diagram when the light amount of the receiving light beam is converted to a transmitting position of the receiving light beam on a density filter;

Fig. 5 is a block diagram of an example of an optical system of the embodiment of the present invention; and

Fig. 6 is a drawing to explain a density filter to be used in the optical system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Description will be given below on an embodiment of the present invention referring to the drawings.

Fig. 1 is a block diagram to show a general arrangement of a distance measuring unit of a first embodiment of the present invention.

A control arithmetic unit 1 issues a light emission control signal to a light emitting unit 2, and the light emitting unit 2 emits a distance measuring light beam 7 to an object to be measured (not shown) positioned outside the system. The distance measuring light beam 7 reflected from the object to be measured is received by a photodetection unit 3 via a beam attenuation unit 6 as a receiving light beam 8. The photodetection unit 3 converts the receiving light 8 to an electric signal. The converted electric

signal is inputted to the control arithmetic unit 1 as a
photodetection signal, and the control arithmetic unit 1
calculates a measured distance value according to the
photodetection signal 1.

The beam attenuation unit 6 comprises a motor driving
unit 4, a motor 5, a density filter 9, etc. The motor
driving unit 4 receives a photodetection amount adjusting
signal from the control arithmetic unit 1. Based on the
photodetection amount adjusting signal, the motor 5 is
rotated at a rotation angle, which corresponds to the
photodetection amount adjusting signal. The density filter
9 is mounted on the rotation shaft of the motor 5 and it is
designed to cut off or shield the receiving light 8.

On the density filter 9, a zero position is determined
as shown in Fig. 2, and the density becomes continuously
denser as it goes away from the zero position. The density
of a group of diameters shown in Fig. 2 indicates density of
the density filter 9. To adjust the photodetection amount,
the control arithmetic unit 1 drives the motor 5 via the
motor driving unit 4 while checking the magnitude of the
photodetection signal from the photodetection unit 3, and
rotates the density filter 9. Then, it controls
transmitting position of the receiving light 8. A stepping
motor is used as the motor 5, and the attenuation amount of
the receiving light 8 can be read from a number of steps
from the position (zero position in Fig. 2) of
transmissivity 1 (without light attenuation amount) of the
density filter 9.

The control arithmetic unit 1 comprises an operation

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unit 10 and a display unit 11. The operation unit 10 has a
data input key (not shown) for inputting data relating to
survey operation and a mode changing switch (not shown) for
switching over to a survey mode using a prism (prism mode)
and a survey mode not using a prism (non-prism mode). On
the display unit 11, a measured distance value, a selected
mode, a distance measuring status, etc. are displayed.

When it is supposed that light emitting intensity of the
distance measuring light beam 7 emitted from the light
emitting unit 2 is constant, light amount of the received
light beam 8 is changed according to reflectivity of the
object to be measured and also to a distance from the
distance measuring system to the object to be measured. For
this reason, when the reflectivity of the reflection surface
of the object to be measured is high or when the distance
from the distance measuring system to the object to be
measured is small, the light amount of the receiving light
beam 8 increases too much. In this respect, before the
receiving light beam 8 enters the photodetection unit 3, it
is attenuated by the beam attenuation unit 6 so that the
light amount is decreased to such an adequate value that the
photodetection unit 3 can receive the light beam.

The receiving light beam 8 changes according to the
reflectivity of the object to be measured and also to the
distance from the distance measuring system to the object to
be measured. It is known that, in case of a corner cube
commonly used in survey operation, it can be calculated by
the following equation:

$$P = (P_0 \cdot S_{ob} \cdot e^{-2\beta \times L}) / (4\pi L^2 \cdot \tan^2 \alpha) \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where

P : Light signal detecting ability (nW)

P_o : Output of objective lens (nW)

S_{ob} : Area of photodetecting objective lens ($\times 10^{-10} cm^2$)

β_x : Attenuation rate in atmospheric air between two points

L : Measured distance (km)

α : Beam spreading angle

On the other hand, in the non-prism survey mode, the distance measuring system receives diffusion light from the surface of the object to be measured and measures the distance, but light amount of the diffusion light which can be received by the distance measuring system is extremely smaller compared with the reflection light beam from the prism. Fig. 3 shows comparison between the diffusion light from the surface of the object to be measured and the reflection light beam from the prism. Fig. 3 is a conceptual representation of the photodetection amount of reflection light beam from a corner cube used in the prism measurement mode and from the object to be measured (natural object) in the non-prism measurement mode. When photodetection sensitivity is changed, a similar trend is found in the photodetection amount in the prism measurement mode and the non-prism measurement mode. In Fig. 3, the curve A represents the photodetection amount of the reflection light beam from the corner cube and the curve B shows the photodetection amount of the reflection light from the natural object.

As described above, the photodetection amount can be

expressed by the number of rotating steps of the density

filter 9 of the beam attenuation unit 6. The receiving

light beam 8 according to the equation (1) is depends on

weather conditions, or dusty conditions at the measuring

site, etc., and the approximate range of changes can be

defined as tolerances. Even if this approximate range of

changes is taken into account, there is an extensive

difference in the photodetection amount between in the prism

measurement mode and in the non-prism measurement mode. Fig.

3 can be re-drawn as shown in Fig. 4 by taking these facts

into consideration. As it is sufficiently evident in Fig. 4,

from the measured distance to the object to be measured and,

when the photodetection amount is turned to an adequate

light amount by the density filter 9, from the density of

the density filter 9, i.e. from the number of rotation steps,

the control arithmetic unit 1 can determine whether the

object is a corner cube or it is a natural object. The

relation between the measured distance L and the number of

the rotation steps of the density filter 9 as shown in Fig.

4 is set in a storage unit (not shown) of the control

arithmetic unit 1 in advance. In Fig. 4, the curve C

represents the number of the rotation steps of the density

filter 9 with respect to the reflection light beam from the

corner cube, and broken lines above and below of the curve C

represent the tolerance. The curve D indicates the number

of the rotation steps of the density filter 9 with respect

to the reflection light from a natural object.

The control arithmetic unit 1 drives the motor 5 via the

motor driving unit 4 based on the photodetection signal from

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the photodetection unit 3 so that the photodetection amount
at the photodetection unit 3 will be an adequate value, and
it rotates the density filter 9.   Further, when the
photodetection amount is turned to an adequate value,
driving pulses from the motor driving unit 4 are counted.
The number of the driving pulses correspond to the number of
the rotation steps of the density filter 9 and also
correspond to the rotating position (density) of the density
filter 9.   The photodetection amount is then adjusted, and
the control arithmetic unit 1 measures the distance to the
object to be measured according to the photodetection signal
from the photodetection unit 3.   The control arithmetic unit
1 determines whether the object to be measured is a corner
cube or other natural object according to the results of the
distance measurement, the number of driving pulses and the
data of Fig. 4.   The results of this judgment is displayed
on the display unit 11 together with the results of the
distance measurement.   Alternatively, the control arithmetic
unit 1 may determine whether the object to be measured is a
corner cube or a natural object according to the data
obtained by the photodetection amount before the light
amount adjustment (the photodetection amount at the density
filter 9 when light is not attenuated) and by the
measurement distance instead of the number of driving pulses.

[Concrete embodiment 1]

In case the display unit 11 is provided with a
changeover switch to select the prism mode and the prism
mode is selected, the control arithmetic unit 1 can
determine whether the object to be measured is a corner cube

or a natural object according to the measured distance and the number of the steps of the beam attenuation unit 6 at that moment. Only when the object to be measured is judged as a corner cube, the display unit 1 displays the measured distance. In case the object to be measured is a natural object (i.e. an object other than corner cube), the display unit 11 does not display the measured distance or display a message of a warning that the corner cube is not measured or collimation is not accurately performed.

[Concrete embodiment 2]

According to the photodetection amount, the control arithmetic unit 1 automatically changes over the photodetection sensitivity, and the fine light amount adjustment is performed at the density filter 9. According to the photodetection amount, it is judged whether the object to be measured is a natural object or a corner cube, and the result of the judgment is displayed on the display unit 11. The user judges the measurement status according to the display.

According to the equation (1) given above, the calculated photodetection amount is changed depending upon various conditions as described above. In order to increase the accuracy to judge whether it is a corner cube or a natural object, the user can input parameters of the distance measuring condition (such as a number or diameters of corner cubes, weather conditions, i.e. a range of visibility, etc.) to the control arithmetic unit 1 by the operation unit 10.

It is desirable that reference values of the light

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amount and the number of steps as the source for judgment and the correcting calculation procedure to correct the photodetection amount according to the inputted data are stored in a storage unit in the distance measuring system main unit, e.g. in the control arithmetic unit 1.

Fig. 5 is a block diagram which more concretely shows the optical system of the present embodiment. In Fig. 5, the same components as shown in Fig. 1 are referred by the same symbols, and detailed description is not given here. The operation unit 10 and the display unit 11 are not shown in this figure.

The measuring light beam 7 and the receiving light beam 8 exit or enter the distance measuring system via an objective lens 22, and a triangular mirror 21 is arranged on the optical axis of the objective lens 22. The measuring light beam 7 emitted from the light emitting unit 2 is guided by an optical fiber 17 for exit light, and the light exit end of the optical fiber 17 for exit light is arranged at a position opposite to the triangular mirror 21. An optical fiber 18 for photodetection having a photodetection end at a position opposite to the light exit end of the optical fiber 17 for exit light is designed in such manner as to guide the receiving light beam 8 toward the photodetection unit 3.

A chopper 19 for changing optical path is disposed between the light exit end of the optical fiber 17 for exit light and the triangular mirror 21, and the chopper 19 for changing optical path is rotated by a chopper motor 16 for optical path change. The chopper motor 16 is driven by a

chopper motor driving unit 15, and the chopper motor driving
unit 15 controls the rotation of the chopper motor 16 based
on a control signal from the control arithmetic unit 1. A
density filter 20 is disposed between the triangular mirror
21 and the photodetection end of the optical fiber 18 for
photodetection, and the density filter 20 is rotated by the
motor 5.

Fig. 6 shows the density filter 20, which has a
reference light attenuation area 20a in the outer peripheral
portion and a receiving light attenuation area 20b at the
central portion. The reference light attenuation area 20a
is continuously designed so that the light amount is
attenuated to 1/10 when rotated by one turn, and it has a
pattern showing the zero position. On the receiving light
attenuation area 20b, the density is changed continuously so
that the light amount is attenuated to $1/10^5$ when it is
rotated by one turn.

When the chopper motor 16 is rotated, the optical path
of the light beam emitted from the light emitting unit 2 is
changed to the measuring light beam 7 or to a reference
light beam 24. The measuring light beam 7 is reflected by
the outer reflection surface of the triangular mirror 21 and
it is projected toward the object to be measured (not shown)
via the objective lens 22. The receiving light beam 8
reflected from the object to be measured is reflected by the
other outer reflection surface of the triangular mirror 21.
Then, it passes through the reference light attenuation area
20a of the density filter 20 and enters the optical fiber 18
for photodetection and is further guided toward the

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photodetection unit 3.

The reference light 24 is reflected by an inner reflection surface of the triangular mirror 21. Then, it passes through the receiving light attenuation area 20b of the density filter 20, enters the optical fiber 18 for photodetection and is guided toward the photodetection unit 3.

When the chopper 19 for changing optical path is rotated by the chopper motor 16, the light beam is changed over to the measuring light beam 7 or to the reference light beam 24. The control arithmetic unit 1 is composed in such manner that it calculates the distance to the object to be measured by subtracting the measured distance value when the reference light beam 24 (for error correction) is selected from the measured distance value when the measuring light beam 7 is selected.

When the reference light beam 24 is selected by the chopper 19 for changing optical path at the start of the operation and the density filter 20 is rotated by the motor 5 and zero position pattern is detected where the transmitted light amount is turned to a discontinuous value, the control arithmetic unit 1 can detect the zero position of the beam attenuation unit 6. After the zero position has been detected, the measuring light beam 7 is selected by the chopper 19 for changing optical path. Then, the control arithmetic unit 1 rotates the motor 5 so that the photodetection amount of the receiving light beam 8 reflected from the object to be measured is turned to an adequate value, and the object to be measured is determined

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as described above.   Specifically, a rotation angle of the density filter 20 is determined, i.e. the number of the driving steps of the motor 5 based on signal from the photodetection unit 3 is counted.   Based on the number of the driving steps thus counted, on the result of the distance measurement and on the reference data relating to the reflection of the object to be measured as shown in Fig. 4, the control arithmetic unit 1 judges whether the object to be measured is a prism (a corner cube) or other natural object.   It may be designed in such manner that a photoelectric conversion detector is disposed on the circumference of the density filter 20 and the rotating position of the density filter 20 may be calculated.   In the above, the density filter 20 is designed in circular shape, while it may be designed in an oblong shape and may be used by sliding.

According to the present invention, it is possible to determine whether the object to be measured is a corner cube or a natural object from the relation between the measured distance value and the photodetection amount, and this eliminates the possibility that the user may not perform correct collimation when the corner cube measurement is selected and may erroneously measure the distance based on the reflection light beam from the object other than the prism.   Therefore, according to the present invention, the measurement can be performed with high reliability.

WHAT IS CLAIMED IS:

1. A distance measuring system, comprising a control arithmetic unit, a light emitting unit for emitting a measuring light beam and a photodetection unit for receiving a reflection light beam from an object to be measured, and said system being used for measuring a distance by receiving said reflection light beam from said object to be measured, wherein said control arithmetic unit compares a signal based on photodetection amount of the light from said object to be measured as well as a result of distance measurement with a reference data prestored in said control arithmetic unit relating to reflection of said object to be measured, and judges said object to be measured based on a result of the comparison.

2. A distance measuring system according to claim 1, further comprising a density filter for adjusting said photodetection amount of said light beam from said object to be measured, wherein said signal based on said photodetection amount represents a density position of said density filter, and said reference data relating to reflection of said object to be measured is obtained by associating a measured distance with said density position of said density filter.

3. A distance measuring system according to claim 2, wherein said density filter is a disk where density is continuously changed in a circumferential direction, said density filter is rotated by a stepping motor, and said density position corresponds to a number of rotating steps of said stepping motor.

4. A distance measuring system according to claim 1, wherein said reference data relating to the reflection of said object to be measured contains change of said photodetection amount due to weather conditions as a tolerance value.

5. A distance measuring system according to claim 1, further comprising a display unit, wherein a result of judgment on said object to be measured is displayed on said display unit.

6. A distance measuring system according to claim 5, wherein there are provided at least a prism measurement mode and a non-prism measurement mode, and when said prism mode is selected, said distance is displayed on said display unit only when said object to be measured is judged as a corner cube, and the fact that said object to be measured is not a corner cube is displayed on said display unit when said object to be measured is not judged as a corner cube.

7. A distance measuring system according to claim 5, wherein photodetection sensitivity can be automatically changed over according to said photodetection amount of said light beam from said object to be measured, said object to be measured is judged according to said photodetection amount, and a result of judgment on said object to be measured is displayed on said display unit.

ABSTRACT OF THE DISCLOSURE

A distance measuring system, which comprises a control arithmetic unit 1, a light emitting unit 2 for emitting a measuring light beam and a photodetection unit 3 for receiving a reflection light beam from an object to be measured, and said system being used for measuring a distance by receiving said reflection light beam from said object to be measured, wherein said control arithmetic unit compares a signal based on photodetection amount of the light from said object to be measured as well as a result of distance measurement with a reference data prestored in said control arithmetic unit relating to reflection of said object to be measured, and judges said object to be measured based on a result of the comparison.
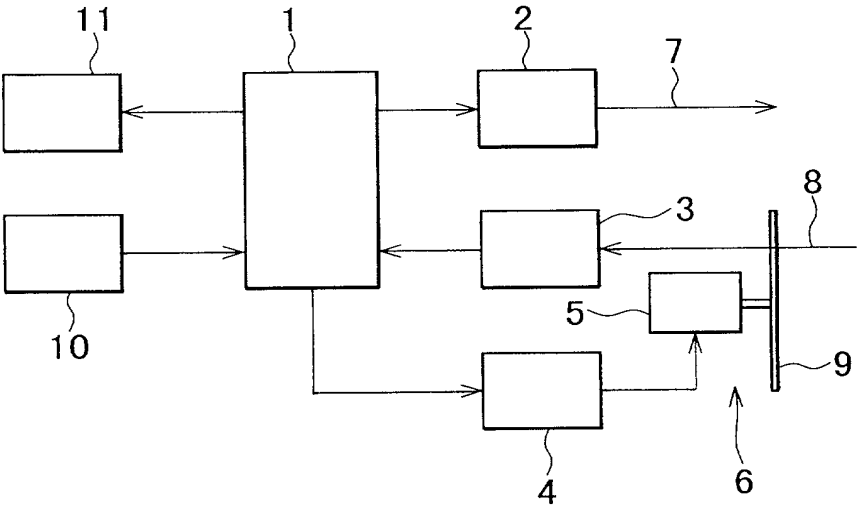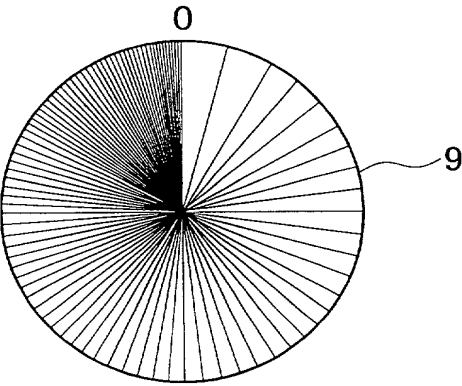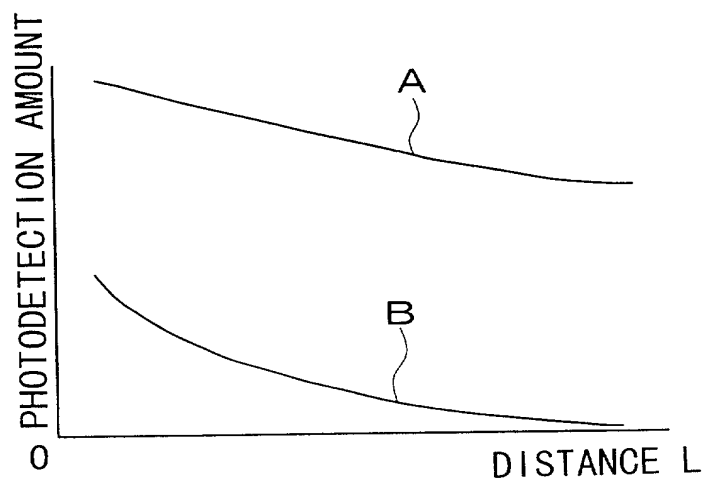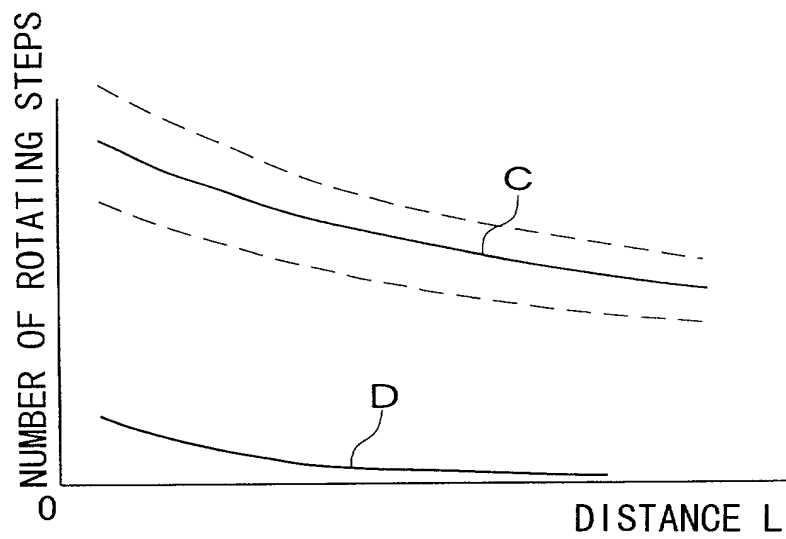
FIG. 1

FIG. 2

FIG. 3

Graph with vertical axis labeled "PHOTODETECTION AMOUNT" and horizontal axis labeled "DISTANCE L", origin marked 0. Curve A is upper, curve B is lower.

FIG. 4

Graph with vertical axis labeled "NUMBER OF ROTATING STEPS" and horizontal axis labeled "DISTANCE L", origin marked 0. Curve C is upper (with dashed bounds), curve D is lower.
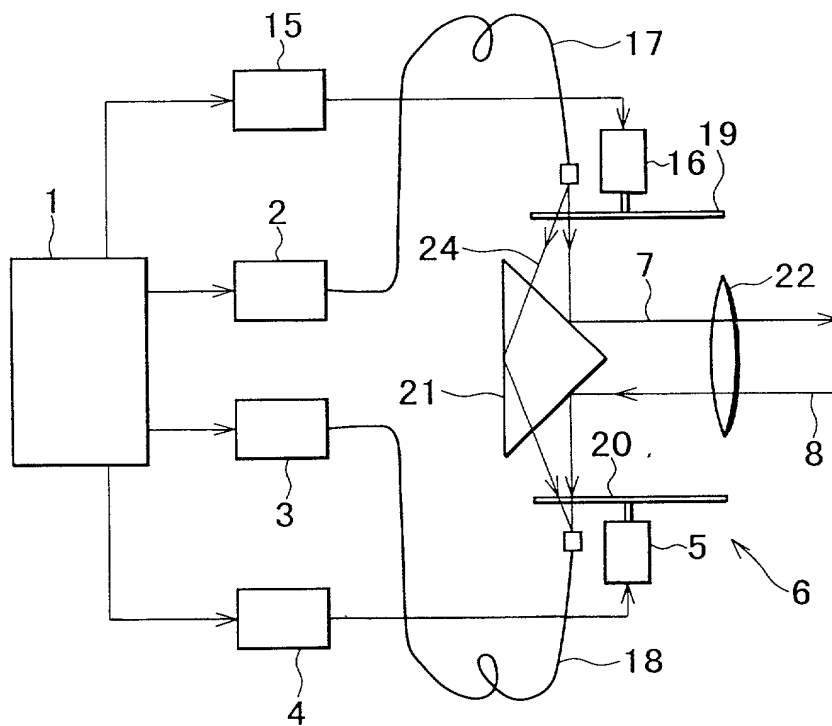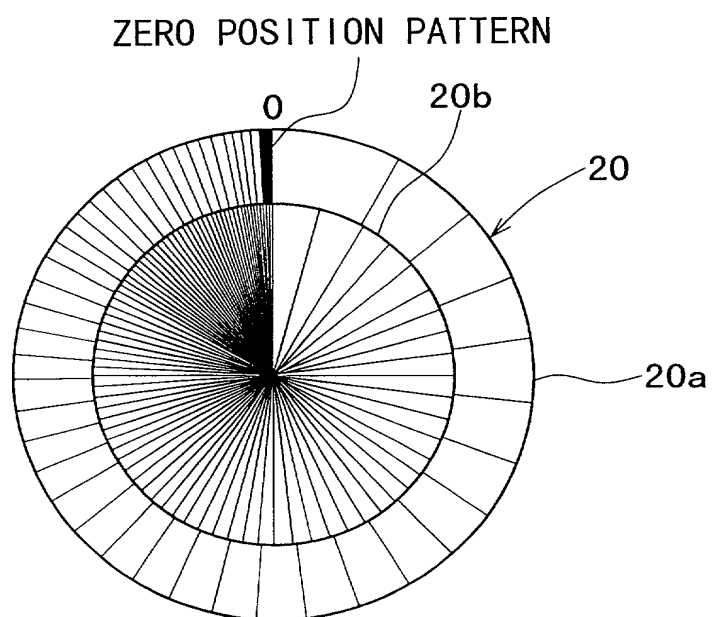
FIG. 5

FIG. 6

ZERO POSITION PATTERN

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled DISTANCE MEASURING SYSTEM _____, the specification of which

(check one) ☒ is attached hereto.
          ☐ was filed on _____ as
          Application Serial No. _____
          and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed	
			Yes	No
134483/1999	Japan	May 14, 1999	X	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status—patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status—patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office, connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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